

# PATENT SPECIFICATION

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## (54) DRYING APPARATUS

(71) We, CHEMIE UND FILTER GMBH VERFAHRENSTECHNIK KG, a German Company of 1m Schumacher-gewann 7, 6900 Heidelberg 1, Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to the drying of air, e.g. for use in the production of ozone, and has as objects the provision of an apparatus and a method therefor.

It is known to provide air drying apparatus having two columns, containing a drying agent, e.g. of the silica gel type. A change-over valve arrangement is provided whereby the dried air can be led to an output and drying air from a blower can be passed through the columns as required.

One column is used to produce the dried air while the other is being regenerated by passing a current of heated air therethrough from the blower in order to extract the moisture which has been removed in producing the dried air. In this way, the apparatus produces a continual supply of dried air.

The columns are fitted at their tops with heaters for heating the air used for drying. At the top end of each column is an entrance pipe equipped with a blower. At the lower end is a connection to the change-over valve arrangement for venting the flow to atmosphere or directing it to the output as required. Usually the output is equipped with its own air pump, so that the blower on a column is only switched on to provide air for regenerative drying. Drying air for regeneration and the processed air pass through the column in the same direction.

In accordance with the present invention, there is provided an air drying apparatus which comprises a pair of substantially vertical columns each containing an air drying agent, a heater at the lower end of each column, passage means connecting the upper end of each column directly with the

atmosphere, a common outlet for air dried by passage through the columns from their upper to their lower ends, an air suction pump in said common outlet, a common inlet for drying air to be heated by the heaters and regenerate the drying agent by passage through the columns from their lower to their upper ends, a blower in said common inlet, and a four-way valve arrangement coupled to the lower ends of the two columns, to the common outlet and to the common inlet, for connecting the lower end of one column with the inlet and the lower end of the other column with the outlet and vice versa.

Further in accordance with the present invention, there is provided a process for drying air which comprises passing air downwardly through a pair of substantially vertical columns used alternately, each of which columns contains a drying agent and has a heater at its lower end, and passing the thus dried air to a common outlet, the airflow downwardly through the columns being drawn from the atmosphere by a suction pump in the common outlet, and regenerating each column, whilst air is being dried by downward passage through the other column, by blowing drying air upwardly therethrough so that it is heated by the heater thereof and is discharged at the upper end of the column after drying-contact with the drying agent, the blowing air being taken from atmosphere by a common inlet provided with a blower, and the connection of the two column with the common inlet and the common outlet being effected by a four-way valve arrangement operable to connect the lower end of one column to the common outlet whilst the lower end of the other column is connected with the common inlet and *vice versa*.

It is characteristic of the apparatus and method of the invention that the air for regeneration and the processed air pass through the columns in opposite directions. The column being used to produce processed air accumulates moisture

especially at the entrance end, but this is quickly removed when the regenerating air is passed through in the opposite direction.

5 Having the four-way change-over valve arrangement and the heaters at the lower ends of the columns gives an economic construction. The heaters can be arranged to produce convection currents which, together with the flow produced by the blower, provide an enhanced regenerative effect. It can be arranged that the blower and the heaters co-operate to heat the drying agent near the heater-ends of the columns so that the dried air is obtained at an elevated temperature and correspondingly reduced humidity.

Damage to the apparatus by over-heated air is minimised in the present arrangement. During regeneration, the blower and the valve arrangement are upstream of the heaters and therefore not affected thereby. The heated drying air for regeneration affects only the columns themselves before being discharged to atmosphere. With the heaters at the bottoms of vertical columns, they cannot affect other parts of the apparatus.

The following description in which reference is made to the accompanying diagrammatic drawing of a preferred embodiment of the apparatus is given in order to illustrate the invention.

The apparatus shown in the drawing has two columns 1 and 2. Each has fitted within its bottom end, an electric heater 3. Above the heater is a perforated plate 4 which supports a filling 5 of a drying agent, for example a silica gel of commercially available type.

40 At the upper end of each column is an entrance pipe 6, open at its top to atmosphere. At the lower end a pipe 7 connects the column with a change-over four-way valve assembly 8 which consists of four separate valves 9, 10, 11 and 12. A connection leads to between valves 9 and 10 from a blower 14. From between valves 11 and 12, an outlet pipe 15, constituting the output of the drying apparatus, connects to apparatus 16, e.g. an ozone apparatus. Suction pump 17 is associated with the apparatus 16 to draw air downwardly through the columns. A control unit 18 serves the four valves 9 to 12 and the blower 14. It consists of a clock arrangement to make the change-overs at previously selected intervals. Alternatively, it can be controlled by a temperature and/or moisture detector 19 in the outlet pipe 15. Detector 19 can be preset to any desired values of temperature or moisture content.

With valve 11 open and the suction pump 17 working, atmospheric air is sucked through the entrance pipe 6 into the column 1 and, after being dried by the drying agent

5, passes through the outlet pipe 15 to the apparatus 16. After a predetermined time, chosen by experience or by measurements, valves 9 and 12 are opened and valve 11 is closed, valve 10 is closed, if it has not already been closed, e.g. at the previous completion of drying column 2. The heater 3 in column 1 and the blower 14 are now started. Air dried in column 2 now passes to apparatus 16 while the blower 14 feeds air upwardly over the heater 3 in column 1. The heated air serves as a drying agent and carries moisture extracted by the drying agent 5 to atmosphere upwardly through the top of column 1 and pipe 6. After an adequate drying period, the heater 3 of column 1 and the blower 14 can be turned off so that the drying agent 5 can cool off. After a further period, the valves arrangement can be operated so that column 1 is again used for drying air whilst column 2 is regenerated.

It will be understood that the foregoing description of specific apparatus is given for purposes of illustration only and that various modifications such as may occur to those skilled in the art may be made without departing from the scope of the invention.

#### WHAT WE CLAIM IS:—

1. An air drying apparatus which comprises a pair of substantially vertical columns each containing an air drying agent, a heater at the lower end of each column, passage means connecting the upper end of each column directly with the atmosphere, a common outlet for air dried by passage through the columns from their upper to their lower ends, an air suction pump in said common outlet, a common inlet for drying air to be heated by the heaters and regenerate the drying agent by passage through the columns from their lower to their upper ends, a blower in said common inlet, and a four-way valve arrangement coupled to the lower ends of the two columns, to the common outlet and to the common inlet, for connecting the lower end of one column with the inlet and the lower end of the other column with the outlet and *vice versa*.

2. Apparatus according to Claim 1 in which the heaters are electrical heaters.

3. A process for drying air which comprises passing the air downwardly through a pair of substantially vertical columns used alternately, each of which columns contains a drying agent and has a heater at its lower end, and passing the thus dried air to a common outlet, the air-flow downwardly through the columns being drawn from the atmosphere by a suction pump in the common outlet, and regenerating each column, whilst air is being dried by downward passage through the other column, by

blowing drying air upwardly therethrough so  
that it is heated by the heater thereof and is  
discharged at the upper end of the column  
after drying-contact with the drying agent,  
5 the blowing air being taken from at-  
mosphere by a common inlet provided with  
a blower, and the connection of the two  
columns with the common inlet and the  
common outlet being effected by a four-way  
10 valve arrangement operable to connect the  
lower end of one column to the common  
outlet whilst the lower end of the other  
column is connected with the common inlet  
and *vice versa*.

4. A process for drying air, substantially as 15  
hereinbefore described and illustrated by  
reference to the accompanying drawing.

5. Dried air when produced by a process  
according to either of Claims 3 or 4.

6. An air drying apparatus substantially as 20  
hereinbefore described and illustrated by  
reference to the accompanying drawing.

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## COMPLETE SPECIFICATION

*This drawing is a reproduction of  
the Original on a reduced scale*

